

In a formal matter, Applicant respectfully notes that the May 31, 2002, Information Disclosure Citation Form (Form PTO-1449) should have listed U.S. Patent No. 5,815,320 (Hoshi, et al.) as --5,815,320-- rather than "5,825,320"; accordingly, Applicant has attached hereto a corrected form PTO-1449 listing the same and respectfully requests that the same be initialed so that the correct number for Hoshi, et al. will be listed as having been considered. Favorable consideration is earnestly solicited.

Claims 38 through 40 were objected to for informalities, and Claim 40 was rejected under 35 U.S.C. § 112, 2nd paragraph, as indefinite on the grounds that the fourth lens unit is not recited. All objections and rejections are respectfully traversed, and are submitted to be obviated by the amendment of the claims in a manner which is believed to avoid each ground of objection and rejection set forth in the Official Action.

Claims 1 through 9, 11, 12, and 35 through 40 were rejected under 35 U.S.C. § 103 over U.S. Patent No. 5,815,320 (Hoshi, et al.) in view of U.S. Patent No. 6,094,313 (Yamanishi). Claim 10 was rejected under 35 U.S.C. § 103 over Hoshi, et al. in view of Yamanishi and U.S. Patent No. 5,978,153 (Nishio). All rejections are respectfully traversed.

Each of Claims 1 and 35 through 40 recites, inter alia, that the first lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the object side of the first lens unit, or the fourth lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the image side of the fourth lens unit, wherein the lens units comprising the zoom lens are only the first, second, third, and fourth lens units.

However, Applicant respectfully submits that none of Hoshi, et al., Yamanishi, and Nishio, even in the proposed combinations, assuming, arguendo, that the documents could be combined, discloses or suggests at least the above-discussed claimed features as recited, inter

alia, in Claims 1 and 35 through 40. It is also respectfully submitted that there has been no showing of any indication of motivation in the cited documents that would lead one having ordinary skill in the art to arrive at such claimed features. The Official Action states that Hoshi, et al. lacks a diffractive optical surface, and therefore relies upon Yamanishi, et al. and Nishio. However, Applicant respectfully submits that Yamanishi, et al. does not specify locating a diffractive optical surface on a specific surface of a specific lens group as claimed. Applicant also respectfully notes that in Nishio, while Fig. 4 shows $+ - + - +$, it has five lens units contrary to what Applicant claims. Applicant respectfully submits that by means of the above-discussed claimed features, it is possible to favorably correct lateral chromatic aberration and at the same time prevent the adherence of dust or scratches on the diffractive optical surface by locating the same on a surface other than the surface closest to the object side of the first lens unit and other than the surface closest to the image side of the fourth lens unit (see, e.g., specification at page 14, line 18 through page 15, line 12).

The dependent claims are also submitted to be patentable because they set forth additional aspects of the present invention and are dependent from independent claims discussed above. Therefore, separate and individual consideration of each dependent claim is respectfully requested.

Applicant submits that this application is in condition for allowance, and a Notice of Allowance is respectfully requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our address listed below.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Daniel Gluck", written over a horizontal line.

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VERSION SHOWING CHANGES MADE TO THE SPECIFICATION

Please substitute the following paragraph for the paragraph starting at page 4, line 4 and ending at line 11.

Of these proposals, U.S. Patent No. 5,268,790 proposes a zoom lens composed of four lens units having positive, negative, positive, and negative optical powers. In the zoom lens, which executes zooming by moving second and third lens units, diffractive optical elements are used in the second lens unit used for zooming and in the third lens unit for correcting variations of an image surface caused by the zooming.

Please substitute the following paragraph for the paragraph starting at page 11, line 23 and ending at page 12, line 7.

In this embodiment, a phase shape ϕ of a diffractive optical surface (diffraction surface) is defined by the following formula.

$$\phi(h,m) = (2\pi/m\lambda_0) (C_1h^2 + C_2h^4 + C_3h^6 \dots) \dots (a)$$

where h denotes a vertical height with respect to the optical axis, m denotes the diffraction order of diffraction light, λ_0 denotes a [designated] design wavelength (that is, the wavelength at which the diffraction surface exhibits the highest diffraction efficiency), and C_i denotes a phase coefficient ($i = 1, 2, 3 \dots$).

Please substitute the following paragraph for the paragraph starting at page 12, line 13 and ending at line 15.

In the embodiment, the diffraction order m of diffraction light is 1, and the [designated] design wavelength λ_0 is the wavelength of a d-line (587.6 nm).

Please substitute the following paragraph for the paragraph starting at page 16, line 13 and ending at line 24.

Ordinarily, the diffraction efficiency of a diffraction grating at a [designated] design order, that is, the order at which light of a particular wavelength is concentrated by the diffraction grating, (for example, the first order) tends to decrease as the wavelengths of light striking the diffraction grating stray from an optimized wavelength of light (that is, a [designated] design wavelength at which the diffraction surface exhibits the highest diffraction efficiency), whereas diffraction efficiency of diffraction light of zeroth and secondary orders, which are other than the [designated] design order but are particularly near thereto, tend to increase.

Please substitute the following paragraph for the paragraph starting at page 18, line 19 and ending at page 19, line 2.

As is apparent from Fig. 14, the diffraction efficiency at the [designated] design order is reduced away from the optimized wavelength of 530 nm, whereas the diffraction efficiency of the diffraction light is increased in the zeroth and second orders which are in the vicinity of the [designated] design order. When the diffraction efficiency of the diffraction light

increases in orders other than the [designated] design order, the diffraction light is made to flare, which reduces the resolution of the optical system.

Please substitute the following paragraph for the paragraph starting at page 19, line 19 and ending at line 23.

As can be seen from Fig. 16, the diffraction efficiency of the [designated] design order has a high diffraction efficiency of at least 95% over the entire wavelength region being used by constructing the diffraction grating as a laminated structure.

Please substitute the following paragraph for the paragraph starting at page 22, line 11 and ending at line 15.

The coefficients of the above formula (a) are written in a phase equation showing the surface of a diffractive optical element. At that time, the [designated] design diffraction order is a first order and a [designated] design wavelength is a d-line.

VERSION SHOWING CHANGES MADE TO THE CLAIMS

1. (Twice Amended) A zoom lens, comprising in sequence from an object side to an image side:

a first lens unit having a positive optical power;

a second lens unit having a negative optical power;

a third lens unit having a positive optical power; and

a fourth lens unit having a negative optical power,

wherein said first, second, third, and fourth lens units move to the object side along an optical axis in zooming from the wide angle end to the telephoto end,

[wherein at least one of said first, second, third, and fourth lens units has at least diffractive optical surface] wherein said first lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the object side of said first lens unit, or said fourth lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the image side of said fourth lens unit,

wherein the lens units comprising the zoom lens are only said first, second, third, and fourth lens units, and

wherein the shape of the surface closest to the image side in said fourth lens unit is convex to the image side.

3. (Amended) A zoom lens according to claim 1, wherein [at least one of said first lens unit and said fourth lens unit comprises said diffractive optical surface] said first lens unit has a diffractive optical surface located on the image side of a lens closest to the object side of said first lens unit, or said fourth lens unit has a diffractive optical surface located on the object side of a lens closest to the image side of said fourth lens unit.

12. (Twice Amended) Optical equipment, comprising:
an optical-equipment element; and
a zoom lens according to claim 1, said zoom lens being connected to said optical-equipment element [, said zoom lens comprising in sequence from an object side to an image side:

a first lens unit having a positive optical power;
a second lens unit having a negative optical power;
a third lens unit having a positive optical power; and
a fourth lens unit having a negative optical power,
wherein said first, second, third, and fourth lens units move to the object side along an optical axis in zooming from the wide angle end to the telephoto end,
wherein at least one of said first, second, third, and fourth lens units has at least diffractive optical surface,

wherein the lens units comprising the zoom lens are only said first, second, third, and fourth lens unit, and

wherein the shape of the surface closest to the image side in said fourth lens unit is convex to the image side].

35. (Amended) A zoom lens, comprising in sequence from an object side to an image side:

a first lens unit having a positive optical power;

a second lens unit having a negative optical power;

a third lens unit having a positive optical power; and

a fourth lens unit having a negative optical power,

wherein said first, second, third, and fourth lens units move to the object side along an optical axis in zooming from the wide angle end to the telephoto end,

[wherein at least one of said first, second, third, and fourth lens units has at least diffractive optical surface] wherein said first lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the object side of said first lens unit, or said fourth lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the image side of said fourth lens unit,

wherein the lens units comprising the zoom lens are only said first, second, third, and fourth lens units, and

wherein said first lens unit consists of a negative lens whose concave surface faces the object side and a positive lens in sequence from the object side to the image side.

36. (Amended) A zoom lens, comprising in sequence from an object side to an image side:

- a first lens unit having a positive optical power;
- a second lens unit having a negative optical power;
- a third lens unit having a positive optical power; and
- a fourth lens unit having a negative optical power,

wherein said first, second, third, and fourth lens units move to the object side along an optical axis in zooming from the wide angle end to the telephoto end,

wherein said first lens unit has [at least one] a diffractive optical surface located on a surface other than a lens surface closest to the object side of said first lens unit, and

wherein the lens units comprising the zoom lens are only said first, second, third, and fourth lens units.

37. (Amended) A zoom lens, comprising in sequence from an object side to an image side:

- a first lens unit having a positive optical power;
- a second lens unit having a negative optical power;

a third lens unit having a positive optical power; and
a fourth lens unit having a negative optical power,
wherein said first, second, third, and fourth lens units move to the object side
along an optical axis in zooming from the wide angle end to the telephoto end,
[wherein at least one of said first, second, third, and fourth lens units has at
least diffractive optical surface] wherein said first lens unit has a diffractive optical surface
located on a surface other than a lens surface closest to the object side of said first lens unit, or
said fourth lens unit has a diffractive optical surface located on a surface other than a lens surface
closest to the image side of said fourth lens unit,
wherein the lens units comprising the zoom lens are only said first, second,
third, and fourth lens units, and
wherein the zoom lens further comprises an aperture stop, and said aperture
stop moves with said second lens unit as a unit in zooming.

38. (Amended) A zoom lens, comprising in sequence from an object side to an
image side:

a first lens unit having a positive optical power;
a second lens unit having a negative optical power;
a third lens unit having a positive optical power; and
a fourth lens unit having a negative optical power,

wherein said first, second third, and fourth lens units move to the object side along an optical axis in zooming from the wide angle end to the telephoto end,

[wherein at least one of said first, second, third, and fourth lens units ha at least diffractive optical surface] wherein said first lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the object side of said first lens unit, or said fourth lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the image side of said fourth lens unit,

wherein the lens units comprising the zoom lens are only said first, second, third, and fourth lens units, and

wherein said second lens unit consists of a negative lens.

39. (Amended) A zoom lens, comprising in sequence from an object side to an image side:

a first lens unit having a positive optical power;

a second lens unit having a negative optical power;

a third lens unit having a positive optical power; and

a fourth lens unit having a negative optical power, [.]

wherein said first, second, third, and fourth lens units move to the object side along an optical axis so that the interval between said first lens unit and said fourth lens unit decreases, in zooming from the wide angle end to the telephoto end,

[wherein at least one of said first, second, third, and fourth lens units has at least diffractive optical surface] wherein said first lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the object side of said first lens unit, or said fourth lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the image side of said fourth lens unit, and

wherein the lens units comprising the zoom lens are only said first, second, third, and fourth lens units.

40. (Amended) A zoom lens, comprising in sequence from an object side to an image side:

- a first lens unit having a positive optical power;
- a second lens unit having a negative optical power;
- a third lens unit having a positive optical power; and
- a fourth lens unit having a negative optical power.

wherein said first, second, third, and fourth lens units move to the object side along an optical axis in zooming from the wide angle end to the telephoto end,

[wherein at least one of said first, second, third, and fourth lens units has at least diffractive optical surface] wherein said first lens unit has a diffractive optical surface located on a surface other than a lens surface closest to the object side of said first lens unit, or

said fourth lens unit has a diffractive optical surface located on a surface other than a lens surface
closest to the image side of said fourth lens unit,

wherein the lens units comprising the zoom lens are only said first, second,
third, and fourth lens units, and

wherein said fourth lens unit comprises a positive lens and two negative lenses.